3.0 Minimum Nurse Aide Staffing Required to Implement Best Practice Care in Nursing Facilities[1]

3.1 Purpose

This report examines nursing facilities (NF) staffing levels necessary to implement care processes associated with positive resident outcomes and identifies how these minimum staffing levels vary depending on the needs of the resident population.

3.2 Background

In the summer of 2000, CMS released a report to Congress entitled, *The Appropriateness of Minimum Nurse Aide Staffing Ratios in Nursing Homes.*[1] This report presented findings from two separate but complementary studies undertaken by two research teams to answer the question, "What should minimum resident-to-nurse-aide staffing ratios be in nursing facilities?" The studies used two different methodologies and addressed two different facets of the research question. Not surprisingly, they arrived at two different answers.

One study focused on the relationship between NF staffing levels and resident outcomes, such as the prevalence of weight loss or pressure sores. This outcomes study retrieved staffing information, hospitalization data, and Minimum Data Set information from nursing facilities in three states.

In contrast, the second study, which is the focus of this chapter, *did* address minimum staffing levels necessary to achieve "good" nursing facility care. Using a different methodology and database than the "outcomes" study, this study examined staffing levels necessary to implement daily care processes in nursing facilities. Five care processes were identified that met two criteria:

- The care processes were associated, either through research evidence or expert consensus, with positive resident outcomes, such as improved quality of life or improved functional status.

---

[1] This chapter was written by John F. Schnelle, Ph.D., Borun Center for Gerontological Research, Los Angeles Jewish Home for the Aging, UCLA School of Medicine, and Sepulveda VA; Sandra F. Simmons, Ph.D., Borun Center for Gerontological Research, Los Angeles Jewish Home for the Aging, UCLA School of Medicine; Shan Cretin, RAND Corporation. Section 3.11 was written by Marvin Feuerberg Ph.D., CMS, with the concurrence of John Schnelle and the assistance of Ed Mortimore, CMS, and Yi-Fei Hu, West Virginia Medical Institute. Dr. Emmett Keeler of the RAND Corporation conducted the workload analysis and Michael Lin of the University of Colorado provided the programming needed to identify variation in resident acuity between homes. Editorial assistance was provided by Anna Rahman.

- There were research data available relevant to how labor intensive it is to implement each care process.

The five care processes that met these two inclusion criteria were:

1. Consistently changing wet linens for incontinent residents who *could not* successfully toilet if given assistance;
2. Providing timely toileting assistance for incontinent residents who *could* successfully toilet;
3. Providing feeding assistance to either physically dependent residents or those with low food intake;
4. Providing exercise to all residents; and
5. Providing assistance that enhances the ability of residents to dress and groom independently.

The study used the available labor intensity data for each care process and a simulation analytic strategy to identify the staffing requirements needed to implement all five of these care processes in nursing facilities. The research question addressed in this "process" study was, "What is the minimum nurse-aide staffing level required to implement care processes that are associated with positive resident outcomes?"

One would expect different staffing projections from the "process" and "outcome" studies because the outcome study attempted to identify minimum staffing levels that signified "bad" care, whereas the process study attempted to identify minimum staffing levels needed to provide "good" care. This expectation was confirmed: the process study showed that 2.9 nurse aide hours per resident per day are necessary to provide "good" care associated with positive outcomes in contrast to the outcome study's estimate that less than 2.0 nurse aide hours per resident per day is likely to result in "poor" care.

One limitation of the process study was that the minimum staffing levels required to implement the five care processes were projected only for an average nursing facilities. Many nursing facilities, however, are not average in the sense that they vary widely in terms of the residents they serve and the care requirements of these residents. In other words, NFs vary in terms of the proportion of residents who need the care processes (e.g., incontinence care or feeding assistance) that were the focus of analysis in this study. Given this, a *range* of minimum staffing ratios is a more meaningful statistic on which to base staffing recommendations than the *average* that was reported in the original study. This report will describe a methodology and research strategy for estimating the range of minimum staffing ratios minimally required to provide good nursing facility care and then present the findings from this research. First, however, investigators will describe the logic of our research approach and discuss some of the features that make this approach particularly appropriate for addressing the primary research question, What should minimum nurse aide staffing ratios in nursing facilities be?

3.3 This Study Estimates the Nurse Aide Staffing Minimally Necessary to Provide a Level of Care Consistent with Federal Quality Standards

The intent of OBRA 1987 and the Federal regulations that were generated by OBRA was to set a standard for achieving the highest practical well being for nursing facility residents. OBRA's intent was not to develop care standards that would prevent *poor outcomes*, but rather to develop standards that would produce *good care*. Together the five care processes examined in this study represent care that is consistent with achieving the highest practical well being for nursing facility residents.[2] This conclusion is based both on empirical findings reported in the research literature and practice guidelines developed by expert consensus panels. Furthermore, the care processes analyzed in this study are specifically mandated in Federal survey standards, which have attempted to operationalize the OBRA standards to facilitate a quality inspection of nursing facilities.[3] Thus, the analytical strategies described in this report provide the most direct approach available to estimate minimum staffing levels necessary to implement Federally mandated care requirements.

3.4 Processes that Define "Good" Care can be Empirically Translated into Minimum Labor Requirements

As mentioned previously, this study included care processes only if an evidence-based case could be made that each process constitutes "good" care that contributes to the well being of residents. The second criteria required that data be available to estimate how labor-intensive it is to implement each care process. These labor-intensity data relate to three domains:

- Information about the average and variation in the time required to implement each care process;
- Information about the number of residents who need the care process; and
- Information about how much time it takes for NF staff to locate residents to provide care.

This information was either retrieved from empirical studies reported in the professional literature or generated from reasonable assumptions based on the best information available. As noted in the original report, some of the "best available" data is incomplete or of suspect quality; a widespread problem in this less-than-perfect industry and one that affects many NF studies, including the previously cited outcomes study, which relies partly on information from resident charts, and the MDS, which are also subject to error. The most important point here, however, is that the time requirements to implement the five care processes are based

---

[2] See CMS's Phase 1 nurse staffing report (chapter 4), CFR 483.25, and Section 6.5.2 below for more detailed discussion of OBRA '87 statutes and derivative regulations.

[3] It is acknowledged that the exercise activities included in the simulation model, beneficial care processes supported by research literature, probably exceed the explicit regulatory requirements for range of motion exercises and ambulation.

not on theoretical speculation, but rather on empirical data or reasonable assumptions generated from the best available data.

These labor-intensity data can be converted mathematically into estimates of the minimum staffing ratios needed to implement all five care processes using simulation analytic strategies. Simulation is an analytical approach designed to identify outcomes associated with different staffing levels and work scenarios. Simulation is a flexible tool that is especially appropriate for evaluating the effects of a nursing facility's physical layout, staffing levels, and service scheduling on the level of services provided, resident waiting time, and staff workload. The simulation models do not create data to predict theoretical outcomes nor are they based on theoretical "unknowns." On the contrary, they take what is known and use these "givens" to mathematically predict outcomes, usually with a high degree of accuracy. Consider a simple example where it is "given" that a car, going at 60 miles an hour, must travel a distance of 120 miles. If one inputs this rate and distance data into a simulation model, the model will predict that the car will reach its destination in two hours. In the study reported here, the simulation models took into account more and somewhat more complex "givens," such as the amount of time needed to provide a service, variability in these service times, the number of residents who need that service, and nurse-aide travel time from one resident to another. Nevertheless, the simulation models' predicted outcomes are as straightforward and as inevitable as the predicted outcome in our example. Again, this is because simulation is an analytical approach that mathematically models a realistic work scenario based on specific input data that characterizes that particular work situation. The models can be generated only if specific data about the work scenario — in other words, the "givens" – are available.

Simulation has been used as an analytic tool in many areas of health care, including emergency departments,[2] operating rooms and surgical suites, [3,4] clinic applications,[5,6] and inpatient applications.[7,8] Many health-care organizations routinely use simulation technologies to predict staffing needs. So, too, do service industries, manufacturers, and government agencies such as the defense department.

MedModel™, a PC-based program, allowed researchers to model both the physical layout of a typical nursing unit and characteristics of the residents. Simulation has the advantage of allowing one to model several realistic work scenarios that take into account factors such as:

- observed variation in the amount of time needed to deliver a service;
- the amount of time nurse aides need to travel from one resident to another;
- the need to accommodate break periods for staff;
- the fact that some services (e.g., morning care and feeding assistance) must be delivered within a relatively narrow time frame, while other care activities (e.g., shower assistance, putting away clean laundry, and exercise) can be worked into available slack periods during the day; and

- the need to accommodate unscheduled events, which may occur at different rates throughout the day.

The computer program's output includes shift-by-shift estimates of workload, estimates of time spent in direct resident care and in travel, estimates of the total minutes devoted to each of the recommended care processes, and the approximate time of day when time-critical services were completed on all residents. In addition to estimating the number of staff needed to complete all five care processes for all residents who needed the services, simulation strategies allowed researchers to generate and validate the effects of variations in staffing levels on the ability of NFs to consistently implement all five care processes. This ability to validate the staffing predictions of simulation models is a particularly important feature of the analytic strategy, and one that makes this strategy highly relevant to efforts to address minimum staffing questions.

3.5 Predictions of Simulation Models can be Efficiently and Scientifically Validated

The research methodology used in this study not only provided very specific predictions about minimum staffing ratios needed to consistently implement all five care processes, but it also predicted outcomes when staffing fell below these minimum levels. For example, in the initial simulation analysis, described in the first report, investigators used staffing levels that typified most of the nation's nursing facilities and assumed that nurse aides worked at probably unrealistically high productivity levels. Based on these assumptions, or "givens," the model predicted that more than 50 percent of nursing facility residents would not receive all five care processes as needed. The first report also cited direct observational data that confirmed this prediction.[9] In these observational studies, investigators working independently of this CMS study reported that staff in typical NFs did not consistently provide feeding assistance, incontinence care, or exercise to most residents.

The fact that the staffing predictions generated by the simulation models could be scientifically validated reflected the applied advantages of this research approach. Though it is not part of the current project to validate these staffing predictions, one could do so fairly easily and efficiently, in part because the CMS-sponsored outcomes study has already described variations in staffing levels across a large number of the nation's NFs. One could use these staffing data to identify NFs that vary across the staffing continuum and then validate the predictions made by the simulation model for homes with various staffing levels. For example, the most obvious hypothesis relevant to CMS's already completed minimum staffing work is that facilities with nurse-aide staffing levels above 2.9 hours per resident per day (the predicted minimum for implementing all five care processes, according to the process study) are significantly better at care process implementation than NFs that fall below this level assuming equal levels of staff productivity. Observational protocols to objectively describe how well the care processes are being implemented are available to test this and other important hypotheses relevant to the staffing questions that are driving CMS's

work in this area. Together, the process study and outcomes study have set the stage for a definitive analysis of NF staffing requirements, which will lead to equally definitive conclusions about minimum staffing.

In summary, the research model described in this report provides a direct, non-theoretical approach to estimating minimum staffing requirements necessary to provide "good" care in NFs. In addition, the model also provides a framework for predicting poor care in NFs that fail to meet these staffing requirements. This methodology can be used to both predict and validate the impact of the different minimum staffing ratios that are being considered as mandated standards for NF.

3.6 How the Current Report Extends and Improves Estimates of Minimum Staffing to Implement the Five Targeted Care Processes

In order to identify the staffing levels needed to implement the five care processes associated with good care, investigators must first identify the proportion of NF residents who need each of several different combinations of the care processes. For example, research staff need to know what proportion of residents need both incontinence care and help with feeding vs. the proportion of residents who need only help with feeding vs. the proportion of residents who are independent in both areas. For each set of residents (and there are more sets, or resident categories, than these three examples), a different amount of staff time will be required to provide "good" care. For example, residents who need both incontinence care and help with feeding will require more staff time than continent residents who can eat independently.

Table 3.1, reproduced from the original CMS report, illustrates the initial effort to identify the proportion of residents who need different combinations of the five care processes. Column 1 in this Table 3.1, reproduced from the original CMS report, illustrates the initial effort to identify the table lists six categories that reflect residents' needs for the five care processes. These categories were constructed based on both empirical data in the research literature and some reasonable assumptions because there are no published data that specifically report the percentage of NF residents who need each of the different care-process *combinations*. There are, however, data that describe the prevalence of each functional disability in isolation (e.g., prevalence of just urinary incontinence in NF residents). There are also other data that describe associations between different disabilities (e.g., a strong positive correlation between incontinence and inability to walk independently). Investigators used both types of data in the first report to indirectly construct the resident categories in Table 3.1.

Table 3.1. Input Data from Original CMS Report

Patient type	Percent of Residents	AM CARE Time	AM CARE Frequency	EXERCISE Time	EXERCISE Frequency	CHANGE OR TOILETING Time	CHANGE OR TOILETING Frequency	REPOSITIONING Time	REPOSITIONING Frequency
1. Continent, Independently ambulatory diapers, no need for repositioning, no ADL enhancements, fully independent ea Frequency: 15% (6 of 40)	15.0%	2	1	30	0.500	0	0	0	0
Standard deviation/Frequency unit			per day		3.5 times/week				
2. Continent, Independently ambulatory diapers, no need for repositioning, AD enhancements needed, fully independent Frequency: 15% (6 of 40)	15.0%	11	1	30	0.500	0	0	0	0
Standard deviation/Frequency unit		7	per day		3.5 times/week				
3. Incontinent, Assisted ambulation, d toilet/night diapers, repositioning ne ADL enhancements needed, fully indepen eating Frequency: 20% (8 of 40)	20.0%	14	1	6	3.000	6	7	3.5	3
Standard deviation/Frequency unit		7	per day		per day	7 (day)5 (night);sd2	per day		per day
4. Incontinent, Assisted ambulation, 2 diapers, repositioning needed, ADL enhancements needed, semi dependent ea Frequency: 40% (16 of 40)	40.0%	14	1	6	3.000	5	8	3.5	2
Standard deviation/Frequency unit		7	per day		per day	2	per day		per day
5. Incontinent, Assisted ambulation, 2 diapers, repositioning needed, ADL enhancements needed, dependent eating Frequency: 4.5% (2 of 40)	5.0%	14	1	6	3.000	5	8	3.5	2
Standard deviation/Frequency unit		7	per day		per day	2	per day		per day
6. Incontinent, Bed bound, 24 hour dia repositioning needed, ADL enhancements needed, dependent eating Frequency: 5. (2 of 40)	5.0%	14	1	2	3.000	5	8	3.5	2
Standard deviation/Frequency unit		7	per day			2	per day		per day
Average time per patient (over all patients):		11.75		16.50		28.40		5.60	

Note: Shift report time (10 minutes per day) is not presented in this table whic care frequency per day and time on a per-resident basis. A total of 10 minutes all residents is assigned to shift report and documentation. The AM and PM care incontinence care, and repositioning may be combined with toileting or changes.

Table 3.1 (continued). Input Data from Original CMS Report

Patient type	Percent of Residents	GROUP FEEDING ASSISTANCE Time	GROUP FEEDING ASSISTANCE Frequency	SHOWER Time	SHOWER Frequency	PM CARE Time	PM CARE Frequency	HOUSEKEEPING Time	HOUSEKEEPING Frequency
1. Continent, Independently ambulatory, no diapers, no need for repositioning, no need for ADL enhancements, fully independent eating Frequency: 15% (6 of 40)	15.0%	1	3	15	0.250	2	1	5	2
Standard deviation/Frequency unit			per day		1.75 times/week		per day		per day
2. Continent, Independently ambulatory, no diapers, no need for repositioning, ADL enhancements needed, fully independent eating Frequency: 15% (6 of 40)	15.0%	1	3	15	0.250	11	1	5	2
Standard deviation/Frequency unit			per day		1.75 times/week	7	per day		per day
3. Incontinent, Assisted ambulation, day toilet/night diapers, repositioning needed, ADL enhancements needed, fully independent eating Frequency: 20% (8 of 40)	20.0%	1	3	15	0.250	14	1	5	2
Standard deviation/Frequency unit			per day		1.75 times/week	7	per day		per day
4. Incontinent, Assisted ambulation, 24 hour diapers, repositioning needed, ADL enhancements needed, semi dependent eating Frequency: 40% (16 of 40)	40.0%	7.5	3	15	0.250	14	1	5	2
Standard deviation/Frequency unit		in groups of 4	per day		1.75 times/week	7	per day		per day
5. Incontinent, Assisted ambulation, 24 hour diapers, repositioning needed, ADL enhancements needed, dependent eating Frequency: 4.5% (2 of 40)	5.0%	22.5	3	15	0.250	14	1	5	2
Standard deviation/Frequency unit		in groups of 2	per day		1.75 times/week	7	per day		per day
6. Incontinent, Bed bound, 24 hour diapers, repositioning needed, ADL enhancements needed, dependent eating Frequency: 5.0% (2 of 40)	5.0%	22.5	3	15	0.250	14	1	5	2
Standard deviation/Frequency unit		in groups of 2	per day		1.75 times/week	7	per day		per day
Average time per patient (over all patients):		17.25		3.75		11.75		10.00	

Note: Shift report time (10 minutes per day) is not presented in this table which illustrates care frequency per day and time on a per-resident basis. A total of 10 minutes of aide time for all residents is assigned to shift report and documentation. The AM and PM care does not include incontinence care, and repositioning may be combined with toileting or changes.

To illustrate the original approach, consider row 1 in column 1, which describes a group of residents who are continent and able to dress, groom, and feed themselves independently. Investigators projected that 15 percent of the total NF population would fall into this category (Table 3.1, row 1. column 2). Investigators arrived at this estimate in the following way: Investigators first estimated that, on average, approximately 30 percent of the NF population is continent, based on research studies that actively recruited residents for incontinence interventions and reported an incontinence prevalence rate of approximately 70 percent. Investigators then projected that about 50 percent of all continent residents, or 15 percent of the total NF population (i.e., half of the 30 percent who were considered continent), would be able to feed, dress, and groom themselves independently. This projection was based primarily on one study which reported that 15 percent of all NF residents need no assistance in any activities of daily living (ADLs). This latter study did not report whether all of these independent residents were continent, but there was good reason to assume that they might be because other studies have reported positive associations between incontinence and increased probability of ADL deficits in other areas. Based on all of these data, investigators projected that all residents who were independent in dressing, feeding, and grooming were probably also continent. Using this kind of logical reasoning, investigators estimated the percentage of residents who would fall into each of the six resident categories (Table 3.1, column 2). The original report provides a more complete description of the data and logic that guided the construction of these categories.

In this current study, investigators improved the methodology by taking a more direct approach to identifying the care-process combinations required by residents and for estimating the proportion of residents who need each combination. This new approach allowed for the identification of three types of NFs that differed significantly from one another with regard to the labor requirements needed to implement the five care processes. These differences stemmed from variations in each facility's resident population (e.g., some NFs care for a higher percentage of residents who required feeding assistance than others). Investigators selected three NFs that reflected a low, medium, and high workload to serve as models for the computer simulations. These simulations were conducted to identify for each of these three NFs the minimum staffing levels necessary to provide good care. Investigators also improved, for this report, the estimates of the time needed to implement the following care processes:

1. Exercise for incontinent residents;
2. Feeding assistance for residents who are both responsive and unresponsive;
3. Number of random events that occur during a shift and the time consumed by such random events; and
4. Travel times to provide incontinence, exercise, and feeding assistance.

The time data for the exercise care processes for incontinent residents were generated from a randomized clinical trial in which 180 residents were assigned to intervention and control groups. The average time required to implement the exercise for the 90 residents assigned to the intervention group was 10 minutes per resident with a standard deviation of 3 when travel time was not considered.[10] Investigators modeled variability for this type of exercise by using a

triangular distribution with a minimum of four minutes, a mode of eight minutes, and a maximum of 18 minutes. The time needed to provide incontinence care was essentially identical to those estimates used in the original report.

The new feeding assistance data were generated for a sample of 68 residents who participated in a trial to evaluate the efficacy of an individual and group feeding assistance intervention. The time data that investigators used in the first CMS report was based on a sub-sample of only 12 of these residents. The new data indicate that all residents receive approximately 1.25 minutes of tray set-up time per meal. Furthermore, group feeding assistance is effective with a ratio of one aide to three residents and consumes approximately 18 minutes per resident per meal with a standard deviation of 5.2 minutes (a minimum of seven minutes, mode of 15 minutes, and a maximum of 32 minutes). Finally, 50 percent of the residents proved unresponsive to feeding assistance (same proportion as estimated in previous report) but investigators collected new data describing the amount of feeding assistance that these unresponsive residents received during usual care NF conditions. Investigators used these new usual-care time data to estimate the labor requirements for these unresponsive residents since investigators know of no more effective feeding assistance intervention at this time. These new data indicated that 55 percent of the responsive residents received zero feeding assistance other than tray set-up (1.25 minutes) and that 45 percent (the more physically dependent) received an average of eight minutes of feeding assistance with a standard deviation of 4.3 minutes (minimum of one minute, mode of three minutes, and maximum of 24 minutes). Investigators also collected travel time for 74 episodes of incontinence care and 23 episodes of assisting residents to the dining room for feeding assistance. The average travel time for incontinence care was 3.5 minutes with a standard deviation of 2.97 while the average travel time for dining room transport was 1.4 minutes with a standard deviation of 1.2. Finally, over 20 hours of observations were conducted for the purpose of estimating the frequency that random events occurred and the time consumed by these events (e.g., answering residents' requests for assistance or cleaning spills). These observations were completed primarily during the time periods between 7am – 9am, 11am – 1pm, and 4pm – 6pm. Based on these observations investigators estimated that each random event consumes approximately two minutes of staff time and occurs with a predicted frequency of six, four, and two events on the 7am – 3pm, 3pm – 11pm, and 11pm – 7am shifts, respectively. The major steps involved in our new research strategy are described next.

3.7 Method

3.7.1 Identify Residents in Need of the Five Targeted Care Processes: MDS Data Analysis

An important task in the current study was to improve the methodology used to distribute residents into categories, which describe the various combinations of the care processes. Investigators accomplished this task by taking advantage of the Minimum Data Set (MDS) information that was available for this project from New York and Ohio. These New York and Ohio MDS data that were available for this study were used in the previously described outcomes study that was designed to identify the staffing levels which predicted poor care.

The MDS is a comprehensive assessment instrument that NF staff are required by federal regulation to complete for all residents on a scheduled basis. Most relevant to this study, the MDS provides data that describes each resident's continence status (bowel and bladder) and rates his or her need for feeding, dressing, and grooming assistance. Data from 674 New York facilities and 972 Ohio facilities were analyzed for the year 1996. This analysis allowed researchers to directly identify the proportion of residents in all NFs in New York and Ohio who needed each of the different care-process combinations.

Table 3.2 lists the resident categories used in our analysis. These categories reflect each of the different care-process combinations. In contrast to the original analysis, which used six resident categories (Table 3.1), the current analysis used nine: the six original categories plus three new ones. The MDS variables and programming rules used to construct each category are presented within brackets in each row of Table 3.2. For example, row 1 describes residents who are continent (scored 0 on both MDS items that reflect continence: H1A=0 and H1B=0) and completely independent in dressing, grooming, and eating (scored 0 or independent on MDS items for grooming, dressing, feeding; g or j and h = 0). This group of residents is the same as the group of residents described in row 1 of Table 3.1.

Table 3.2
Percent of Residents in New York and Ohio in Different Categories

	RESIDENT CATEGORIES	NEW YORK	OHIO
1	Continent: bowel and bladder: independent eating, dressing, and grooming [H1A0 and H1B0 and G1A g or j and h = 0]	5.13	2.47
2	Continent: assistance needed in dressing, grooming – independent feeding [H1A0 and H1B0 and G1A g or j ≥ 1; h = 0]	11.5	9.4
3	Continent: ADL assistance needed in dressing, grooming, and eating [H1A0 and H1B0 and G1A g or j ≥ 1; h ≥ 1]	11.5	19.0
4	Continent: no assistance in dressing, grooming but some assistance in eating [H1A0 and H1B0 and G1A g or j = 0; h ≥ 1]	.04	.77
Total % Continent		**28.6**	**31.6**

Table 3.2
Percent of Residents in New York and Ohio in Different Categories

	RESIDENT CATEGORIES	NEW YORK	OHIO
5	Incontinent: either bowel or bladder – needs dressing, grooming assistance but not feeding assistance [H1A ≥ 1 or H1B ≥ 1 and G1A g or j ≥ 1 and h = 0]	13.3	8.9
6	Incontinent: either bowel or bladder: assistance needed with dressing, grooming, and some feeding assistance [H1A ≥ 1 or H1B ≥ 1 and G1A g or j ≥ 1 and h ≥ 1]	57.3	58.9
7	Incontinent: either bowel or bladder: no assistance needed with dressing, grooming, or feeding assistance [H1A ≥ 1 or H1B ≥ 1 and G1A g or j = 0 and h = 0]	.73	.43
8	Incontinent: either bowel or bladder: no assistance needed with dressing, grooming – some assistance with feeding [H1A ≥ 1 or H1B ≥ 1 and G1A g or j = 0 and h ≥ 1]	.05	.10
Total % Incontinent		**71.4**	**68.3**
9	Bed-bound* [G6A checked]	3.2	6.1

* This group subsumed under Group 6 – numbers add up to more than 100% if this category is added.

In an effort to distribute all NF residents into plausible resident categories and to test the assumption that there are positive associations between different functional disabilities (e.g., that continent residents are more independent in dressing and grooming than incontinent residents) investigators identified resident categories that were not considered in the original study. For example, in the original analysis, investigators projected that no continent residents would need feeding assistance. In the current analysis, investigators tested this assumption, analyzing the MDS data to determine whether, in fact, there were continent residents who needed help with feeding. As explained below, investigators found that there were.

Table 3.2 illustrates several important points. First, these resident categories capture 100 percent of the NH population in New York and Ohio, as can be seen by adding the percentages in rows 1 through 8. The bed-bound category (row 9) is not included in this summation because it is completely subsumed under the row 6 resident category (i.e., incontinent residents who need help with feeding, dressing, and grooming), as will be discussed later. Second, Table 3.2 shows that the proportion of residents who are continent approximates the 30 percent prevalence estimate that investigators used in the original report.

Third, the resident categories and the proportion of residents in each category appear to be clinically valid based on data reported in the professional literature and clinical experience. For example, rows 1 and 7 show that almost all residents who could dress, groom, and feed themselves were also continent. One would expect this finding as a corollary to a related

research finding reported in the professional literature: that is, as mentioned previously, that there is a strong positive association between being incontinent and having ADL deficits in other areas. The clinical validity of the data in Table 2 is further underscored when one considers rows 4 and 8. The data presented in these rows show that there are very few residents who can dress and groom themselves but need help with eating. This finding is expected given clinical data that indicate individuals lose the ability to dress and groom themselves well before they lose the ability to feed themselves.

A fourth point worth noting, and mentioned previously, is that this current analysis identified two new resident categories that were not identified in the original report. The most important new category appears in row 3, which shows there is a substantial proportion of continent residents who require some assistance with feeding (and dressing, grooming). Investigators originally projected that no continent residents would need feeding assistance based on the untested, and apparently incorrect, assumption that the very strong associations reported between continence status and independence in other ADL areas would also extend to the feeding area. On a more minor note, row 7 describes another new resident category comprised of a very small percentage of residents (about 1 percent) who are incontinent but require no assistance in other ADL areas. It is not surprising that this proportion is small, given that the primary risk factors for urinary incontinence in NF residents are dementia and mobility deficits, which in turn means that most incontinent residents would likely need help in other ADL areas. However, a small proportion of residents in this category does reflect a clinical reality. It is known that there are some ambulatory and cognitively intact NF residents who are incontinent primarily due to the same medical factors that contribute to incontinence in a community population (e.g., stress incontinence).

A fifth point to note is that there are only relatively small differences between the New York and Ohio data, which one might expect with such large samples of residents. These similarities suggest that the two state NF populations could be combined for some analyses. Our final point with regard to Table 3.2 is that the proportion of residents who are classified as bed-bound in both states approximates the proportion of residents that investigators estimated to be bed-bound in the original CMS study. It should also be noted that virtually all of the bed-bound residents, not surprisingly, show the same characteristics of residents in category 6; that is, they are incontinent and need assistance with dressing and grooming as well as some help with feeding. Given this, investigators combined the bed-bound residents with residents in category 6; thus, effectively investigators used only eight resident categories in the further work load analyses.

The next step in the analysis was to identify how resident populations vary at the facility level with respect to the different resident categories. This in turn would indicate the degree to which staffing requirements vary from one facility to another.

3.7.2 Identify Nursing Facilities that Vary in Staffing Requirements to Implement the Five Care Processes

To deal with uncertainties in modeling, policy analysts are advised to conduct sensitivity analyses.[11] To do so, analysts study the impact on results of varying assumptions on key parameters across a wide but plausible range. The goal is an understanding of how results vary with assumptions, and the development of flexible policies that will be satisfactory across a wide range of conditions and developments. This section describes some analyses undertaken to develop a small set (three) of typical NFs that could represent the spectrum of workloads that are commonly seen.

Our goal for this study was to identify a set of NFs whose resident populations would represent a range of demands for staff assistance. Initially, investigators attempted to identify clusters of NFs with similar resident mixes, but these mixes varied widely across facilities, without any clear clusters. Instead, investigators divided the NFs into three separate groups based on each facility's average workload, and then created a representative nursing facility for the low, middle, and high work groups.

Investigators used the 1996 MDS data from both states and dropped the 34 percent of homes in the database with less than 10 residents per facility, based on the assumption that these data were either incomplete or reflected small hospital-based facilities, which are atypical of most NFs.

Staff burden varies with the percentage of residents who need different types of care. Given this, NF residents were initially grouped separately by state according to the eight categories listed in Table 3.2, and investigators did not see major differences between states. As noted previously, these categories reflect the different care combinations needed by residents and thus, the different staffing levels required. Again, investigators did not include in this analysis category 9, the "bed-bound" category, because virtually all of these residents were included in category 6 (incontinent, needs assistance with dressing, grooming, and feeding). In Table 3.3, investigators report the percentage of *all* NF residents, in New York and Ohio combined, in each of the eight categories.

Table 3.3
Distribution of Residents in New York and Ohio Across Resident Categories with Different "Work" Values

RESIDENT CATEGORIES		% of Residents New York & Ohio	Assumed Work Points
1	Continent: bowel and bladder: independent eating, dressing, and grooming [H1A0 and H1B0 and G1A g or j and h = 0]	4	0
2	Continent: assistance needed in dressing, grooming – independent eating [H1A0 and H1B0 and G1A g or j $\geq$ 1; h = 0]	10	0
3	Continent: ADL assistance needed in dressing, grooming, and eating [H1A0 and H1B0 and G1A g or j $\geq$ 1; h $\geq$ 1]	14	2
4	Continent: no assistance in dressing, grooming but some assistance in eating [H1A0 and H1B0 and G1A g or j = 0; h $\geq$ 1]	.5	2
5	Incontinent: either bowel or bladder – needs dressing, grooming assistance but not feeding assistance [H1A $\geq$ 1 or H1B $\geq$ 1 and G1A g or j $\geq$ 1 and h = 0]	12	1
6	Incontinent: either bowel or bladder: assistance needed with dressing, grooming, and some feeding [H1A $\geq$ 1 or H1B $\geq$ 1 and G1A g or j $\geq$ 1 and h $\geq$ 1]	59	3
7	Incontinent: either bowel or bladder: no assistance needed with dressing, grooming, or feeding [H1A $\geq$ 1 or H1B $\geq$ 1 and G1A g or j = 0 and h = 0]	.6	1
8	Incontinent: either bowel or bladder: no assistance needed with dressing, grooming – some assistance with feeding [H1A $\geq$ 1 or H1B $\geq$ 1 and G1A g or j = 0 and h $\geq$ 1]	.07	3

The last column of Table 3.3, *Assumed Work Points*, presents a crude four-point "work" scale that takes into account the additional staff time needed to provide feeding assistance and incontinence care. These values reflect research findings that feeding assistance requires more time than incontinence care and also increases demands on staff because it must be delivered during defined mealtime periods. In contrast, incontinence care can be scheduled and provided throughout a 24-hour period, and so does not create a "peak work demand" scenario, which would necessitate increased staffing. No work value was assigned to assistance with dressing and grooming because only a very small percentage of residents did not need this type of care in all facilities. Furthermore, because all residents require exercise to prevent physical and functional decline, investigators considered the exercise care process to be a workload constant that did not differentiate groups. Hence, investigators did not assign a workload value to exercise care.

In our analysis, the resident groups associated with the lowest workload (i.e., a workload score of 0) were those in which the residents were continent and able to feed themselves (Groups 1 and 2). Groups with the highest workload score (i.e., a workload score of 3) were those in which the residents needed both incontinence care and feeding assistance (Groups 6 and 8). Groups 5 and 7 had a workload score of 1 because residents in these groups needed incontinence care but were able to feed themselves. Groups 3 and 4 had a workload score of 2 because residents in these groups needed feeding assistance but not incontinence care.

Based on the data in Table 3.3, investigators combined resident categories with the same workload scores to get a total of four categories:

- Type A: continent, no feeding assistance (Table 3.3 categories 1 & 2);
- Type B: continent, needs feeding assistance (Table 3.3 categories 3 & 4);
- Type C: incontinent, no feeding assistance (Table 3.3 categories 5 & 7); and
- Type D: incontinent, needs feeding assistance (Table 3.3 categories 6 & 8).

The next step was to see whether the NFs in the sample were clustered in each of the four categories. If for example, most homes specialized in almost entirely continent or almost entirely incontinent residents, facilities would be clustered along the lines A+B = 100 percent and C+D =100 percent, and you could pick a few facilities from these lines, ignoring distributions of resident types that are not seen in real world nursing facilities. In each NF, if you add up the percentage of residents in each of the four categories, the total will be 100 percent. Thus, each facility lies on a three-dimensional subspace, because each facility's resident mix can be fully determined if investigators know just three of the four percentages (subtract the sum of the three percentages from 100 percent and you'll get the fourth percentage).

The correlation across NFs between percentage of type A and percentage of type C was .5, and between percentage of type B and percentage of type D was .2. All the other cross-type correlations were below -.5. In other words, this means that NFs typically have (or report) *either* a high percentage of residents who need feeding assistance *or* a low percentage of residents who need feeding assistance, independently of what fraction they have that are continent. So, the last attempt to find clusters was to inspect two-way plots of percentage in A and C versus percentage B. There was wide variation in both measures but no clusters were apparent.

Next, investigators created a set of three typical nursing facilities that together represent a range of staffing demands. Investigators multiplied the percentage of residents in each of the eight categories by the work points associated with that category, then summed the results to get the average work points for each facility. This varied from 0, if no residents needed feeding assistance or incontinence care, to 3, if all residents need both types of care. In fact, average workload had a mean of 2.23, and a standard deviation of .44 among NFs. The tenth percentile of NFs had a value of 1.61 and the 90^{th} percentile had a value of 2.72.

To create a set of three typical NFs with average work demands that ranged from low to middle to high, investigators divided the facilities into three equal-sized groups based on their average work points. Low- work NFs had average work-point values below 2.0 and high-work NFs had average values above 2.25. For each of these three groups, investigators averaged the percentage of residents in each of the eight resident categories. The results, presented in Table 3.4, describe the resident population of each of our three synthetic NFs: the low-work NF, the middle-work NF, and the high-work NF.

Table 3.4
Percent of Residents in Each Category for a Low, Middle, and High Work Facility

RESIDENT CATEGORIES		Low Work	Middle Work	High Work
1	Continent: bowel and bladder: independent eating, dressing, and grooming [H1A0 and H1B0 and G1A g or j and h = 0]	7.5	2.4	.4
2	Continent: assistance needed in dressing, grooming – independent feeding [H1A0 and H1B0 and G1A g or j ≥ 1; h = 0]	18.2	8.9	1.4
3	Continent: ADL assistance needed in dressing, grooming, and eating [H1A0 and H1B0 and G1A g or j ≥ 1; h ≥ 1]	7.0	14.9	22
4	Continent: no assistance in dressing, grooming but some assistance in eating [H1A0 and H1B0 and G1A g or j = 0; h ≥ 1]	.3	.7	.8
5	Incontinent: either bowel or bladder: needs dressing, grooming assistance but not feeding assistance [H1A ≥ 1 or H1B ≥ 1 and G1A g or j ≥ 1 and h = 0]	20.8	9.9	1.6
6	Incontinent : either bowel or bladder: assistance needed with dressing, grooming, and some feeding assistance [H1A ≥ 1 or H1B ≥ 1 and G1A g or j ≥ 1 and h ≥ 1]	40.3	57.6	67.6
7	Incontinent: either bowel or bladder: no assistance needed with dressing, grooming, or feeding assistance [H1A ≥ 1 or H1B ≥ 1 and G1A g or j = 0 and h = 0]	1.3	.5	.1
8	Incontinent: either bowel or bladder: no assistance needed with dressing, grooming – some assistance with feeding [H1A ≥ 1 or H1B ≥ 1 and G1A g or j = 0 and h ≥ 1]	.1	.2	.2
9	Bed Bound	4.5	4.9	5.9

These three synthetic nursing facilities represent approximately the 17, 50, and 83 percentiles of the work distribution. Together, they demonstrate how staffing requirements vary across nursing facilities depending on the residents' service needs. There are many NFs with similar resident mixes at about those points in the work distribution; however, the "average" NFs that investigators used in this analysis to represent the low, middle, and high workload categories have less unwanted variation in the rare categories of residents. Moreover, row 1 of Table 3.4

indicates that, as hoped for, the workload weighting procedure investigators used for incontinence care and feeding assistance discriminated between NFs with respect to the percentage of residents who were independent in dressing, grooming, and feeding; 7.5 percent, 2.4 percent, and 0.4 percent of residents in the low, middle, and high work facilities, respectively, are actually rated on the MDS as independent in all three care-process areas. This discrimination reflects the fact that the low-workload facilities not only have fewer residents in need of incontinence care or feeding assistance, but also a higher proportion of residents who are independent in dressing and grooming. Investigators next completed staffing simulations to project staffing requirements to implement care for the seven categories of residents illustrated in Table 3.4. Investigators eliminated categories 4 and 8 from Table 3.4 because of the low number of residents who need these care process combinations (investigators projected zero residents to be present on a 40-bed floor in most homes in these categories). The resident categories listed in Table 3.4 that investigators did utilize in the simulations were 1, 2, 3, 5, 6, 7, and 9. The bed-bound category (Category 9) is distinct from category six because the bed-bound residents require less time consuming range of motion exercise as opposed to 10 minutes of mobility exercise integrated with incontinence care. Both groups 6 and 9 need assistance with incontinence, feeding, and dressing/grooming.

3.7.3 Analytical Approach: Simulation Logic

The advantages and logic of the analytical approach involved in the staffing simulations were discussed previously in this chapter and in other published studies.[2-8] The output of the program for this report included shift-by-shift estimates of: 1) time spent in direct resident care and in travel, 2) estimates of the total minutes devoted to each of the recommended services, 3) the approximate time of day when time-critical services were completed on all residents and what percentage of care processes could not be completed.

For the physical layout, investigators used a 40-bed nursing unit with a T-shaped floor plan and a centrally located nursing station and dining hall. Each branch of the T was equipped with a bathroom and a shower. Investigators assumed that toilets and sinks were available in each resident's room.

Based on resident characteristics, investigators created a schedule of recommended services and the estimated times to complete them. Nurse aides were assigned to typical shifts, with two scheduled 15-minute breaks and a 30-minute meal period. The simulation of a 24-hour period involved:

- the arrival and departure of staff, with five minutes for shift reports at the beginning and end of each 8-hour shift and breaks occurring as close to their scheduled times as possible without interrupting already in-progress service to a resident;

- provision of scheduled services, with aides traveling from one resident to the next to deliver care, spending the estimated times appropriate to each resident type; and

- random, unscheduled demands for services (representing resident call lights, spills, accidents, and similar events).

Morning care was scheduled at 6:00 AM and breakfast at 7:00 AM. Lunch and dinner were scheduled at 12:00 am and 5:00 PM and PM care at 7:00 PM. Incontinence care and repositioning was scheduled approximately every two hours throughout the 7:00 AM to 11:00 PM period, but investigators reduced the frequency of care in the 11:00 – 7:00 shift in consideration of sleep to approximately every three hours. Care activities were integrated for efficiency whenever possible (e.g., incontinence care, repositioning, and exercise) and were scheduled during time periods when the most staff time was available. In scenarios where staffing was inadequate to provide all care, the provision of feeding assistance was prioritized and waiting times for other care activities were increased or completely omitted.

Simulations were conducted for 10 different NF staffing levels which ranged from those commonly found in the nation's NFs to the higher levels that investigators determined were needed to complete all care processes with minimal waiting times for service. Since variability in the time to provide care influences any one staffing simulation, investigators conducted multiple simulations for each staffing level so as to estimate the range of waiting times that would be caused by the variability to provide service (e.g., sometimes incontinence care can be completed in five minutes and other times it takes eight minutes). Investigators describe in this report, the most common outcome for each resident to staff ratio tested. The major outcomes upon which investigators will focus this report are:

1. The percent of recommended minutes of care which are scheduled that are likely to be delivered.
2. The probable length of wait for incontinence care or assistance during a meal.
3. The percent of available time that staff would have to work to provide the scheduled care processes (a productivity estimate).

In regard to this latter issue of productivity, investigators did not attempt to limit the percent of time that staff actually worked of their available time, but instead allowed the simulations to determine how much time staff would have to work to implement all care. In many cases, this resulted in unrealistically high productivity estimates as is reflected by the statistic, time involved in direct resident care divided by the total work time available. The high productivity requirements, thus, make the staffing simulations extremely conservative estimates of the actual time needed to provide all care.

3.7.4 Simulation Input Data

Table 3.5 illustrates the input data that investigators used in the staffing simulations. The first column shows the estimated distribution of residents across the seven categories of care processes, which encompasses 100 percent of the residents in the low, middle, and high workload facilities.

These numbers were reviewed previously and discussed in this chapter. The second column shows the number of residents (as opposed to percentage) who required the different care process combinations in a typical 40-bed unit. The remaining seven columns illustrate the time to provide care in minutes and the frequency that care is provided for each resident category. A complete discussion and justification for how these numbers were derived was provided either in the first report or in this chapter for those care processes for which new data were available. In all cases, the numbers were based either on published literature or time and motion data that is being collected in ongoing intervention studies. Next, investigators will briefly describe the input data illustrated in Table 3.5.

Residents who need assistance with ADL care in the morning or evening (groups 2, 3, 4, 5, & 7) were estimated to receive 11 minutes of assistance, which did not include changing, repositioning, or toileting assistance times. Residents who were ambulatory were scheduled for 20 minutes of exercise every other day, while incontinent residents received exercise integrated with incontinence care three times a day for an average of 10 minutes (column 4, rows 4 & 5). Bed-bound residents received only range of motion exercise (estimated 2 minutes per episode) 3 times per day, which was also integrated with incontinence care and repositioning. Residents who were incontinent and who were projected to be responsive to toileting assistance (approximately 40 percent of all incontinent residents) received 7 toileting assists or changes in a 24-hour period with the changes occurring at night between 11pm and 6am. These estimates were based on recent data, which suggest that residents who are responsive to daytime toileting programs are not responsive at night and will require changing.[12] The residents projected to be unresponsive to toileting assistance (approximately 60 percent) received 8 incontinence care episodes per 24-hour period, which matches their average frequency of incontinence according to one report. All incontinent residents received an additional 2 – 3 repositioning episodes per day independent of incontinence care. The frequency of either incontinence care or repositioning was reduced during the 11 pm to 7 am shift to facilitate sleep (three episodes of care between 11 pm – 7 am). Thus, all incontinent residents received a minimum of 10 episodes of either incontinence care and/or repositioning.

Table 3.5. Input Data for Current Simulation

New Patient Type	Estimated Distributions			Frequency in 40 Bed Unit			AM care excluding change or toilet (once per day per patient)	Exercise (excluding change or toilet)	Exercise frequency	Change or toilet time (includes repositioning if needed)	Change or toilet frequency (count includes AM/PM care)
	LOW WORK LOAD	MIDDLE WORK LOAD	HIGH WORK LOAD	LOW WORK LOAD	MIDDLE WORK LOAD	HIGH WORK LOAD					
1. Continent, Independently ambulatory, no need for repositioning, no need for ADL enhancements, fully independend eating	7.5%	2.4%	0.4%	3.0	1.0	0.0	2	20	0.5	0	0
2. Continent, Independently ambulatory, no need for repositioning, ADL enhancements needed, fully independent eatin	18.2%	8.9%	1.4%	7.0	3.0	1.0	11	20	0.5	0	0
3. Continent, Independently ambulatory, ADL enhancements some feeding assistance	7.0%	14.9%	22.0%	3.0	6.0	9.0	11	20	0.5	0	0
Continent, independently ambulatory, no ADL enhancements, some feeding assistance	0.3%	0.7%	0.8%	0.0	0.0	0.0	2	20	0.5	0	0
4. Incontinent, Assisted ambulation *day toileting/nigh diapers*, repositioning neede ADL enhancements needed, ful independent eating	20.8%	9.9%	1.6%	8.0	4.0	0.0	11	10	3	7.5 day, 5.5 night	7
5. Incontinent, Assisted ambulation *day toileting/ nig diapers*, repositioning neede ADL enhancements needed *some or full feeding assistance*	40.3%	57.6%	67.6%	16.0	23.0	27.0	11	10	3	7.5 day, 5.5 night	8
6. Incontinent, day toileting diapers no ADL assistance, f independent eating	1.3%	0.5%	0.1%	1.0	1.0	0.0	2	20	0.5	7.5 day, 5.5 night	8
Incontinent, no ADL assistan some or full feeding assista	0.1%	0.2%	0.2%	0.0	0.0	0.0	2	20	0.500	5.5	8
7. Incontinent, Bed bound, 2 hour diapers, repositioning needed, ADL enhancements nee dependent eating	4.5%	4.9%	5.9%	2.0	2.0	3.0	11	2	3	5.5	8
	100.0%	100.0%	100.0%	40.0	40.0	40.0					

Table 3.5 (continued). Input Data for Current Simulation

New Patient Type	Reposition time (when done without change or toileting)	Reposition frequency	For those needing assistance: Assume 50% responsive get 1-3 intervention, 50% unresponsive get "usual care": Bedbound get same time as 1-3 intervention Tray delivery and setup (Everyone gets this each meal)	1 on 3 Feeding assistance time	Usual Care Feeding assistance time	Feeding assistance frequency	Shower time (every fourth day per patient)	PM care time (once per day per patient)	House-keeping (once per day per patient)	Unexpected events (frequency for whole unit)	Shift report (at end and beginning of each shift)	Travel at 1.5 min/trip
1. Continent, Independently ambulatory, no need for repositioning, no need for ADL enhancements, fully independende eating	0	0	1.25	0	0	3	15	2	5	Day shift: per unit, 2 minutes per event	5	Day shift: trips per patient
2. Continent, Independently ambulatory, no need for repositioning, ADL enhancements needed, fully independent eating	0	0	1.25	0	0	3	15	11	5	Evening shif 4 per unit, minutes per event	5	Evening shift 3 tri per patien
3. Continent, Independently ambulatory, ADL enhancements, some feeding assistance	0	0	1.25	18	55%: 0 45%: 8	3	15	11	5	Night shift: per unit, 2 minutes per event	5	Night shif 2 trips pe patient
Continent, independently ambulatory, no ADL enhancements, some feeding assistance	0	0	1.25	18	55%: 0 45%: 8	3	15	2	5			
4. Incontinent, Assisted ambulation *day toileting/nigh diapers*, repositioning needec ADL enhancements needed, ful independent eating	3.5	3	1.25	0	0	3	15	11	5			
5. Incontinent, Assisted ambulation *day toileting/ nigi diapers*, repositioning needec ADL enhancements needed *some or full feeding assistance*	3.5	2	1.25	18	55%: 0 45%: 8	3	15	11	5			
6. Incontinent, day toileting, diapers no ADL assistance, fu independent eating	0	0	1.25	0	0	3	15	2	5			
Incontinent, no ADL assistanc some or full feeding assistar	0	0	1.25	18	55%: 0 45%: 8	3	15	2	5			
7. Incontinent, Bed bound, 2 hour diapers, repositioning needed, ADL enhancements neec dependent eating	3.5	2	1.25	18	55%: 0 45%: 8	3	15	11	5			

The feeding assistance input data are illustrated in column 7. Investigators estimated that 50 percent of the residents needed and would be responsive to feeding assistance, which could be delivered in groups of 3 residents at a cost of approximately 18 minutes per resident. This 18-minute estimate did not include travel time to bring each resident to the dining room. Observational data also indicated that 50 percent of the residents with low intake would not be responsive to feeding assistance and that there were two subgroups within this unresponsive group. One subgroup (55 percent) was observed to receive no assistance during meals other than tray set up. This latter group was generally rated as independent on the MDS feeding assistance item and many of this group did eat significantly less than 75 percent of the food offered. The other subgroup (45 percent) was observed to receive an average of 8 minutes of assistance per meal. These residents were generally rated on the MDS as requiring assistance at levels 2 through 4 on the feeding assistance item.

Finally, investigators projected that all residents would need bathing assistance every fourth day and that general housekeeping activities, such as chart documentation and shift reports, would consume approximately 5 minutes at the beginning and end of each shift. Randomly occurring events, such as cleaning spills or reacting to residents' requests or emergencies, were projected to occur at a rate of 6 per shift on the 7 am - 3 pm per shift, 4 per shift on the 3 pm – 11 pm, and 2 per shift on the 11 pm – 7 am. The time consumed by these events averaged 2 minutes per resident. Investigators estimated that travel times consumed approximately 1.5 minutes per trip (the lowest estimate of all the data investigators collected) and investigators furthermore estimated that there would be 5, 3, and 2 trips per resident, respectively, during the three shifts. This number of trips also assumed that staff would be highly efficient and would integrate care activities, such as exercise and incontinence care, when possible. Variability in time to provide feeding assistance and exercise was accounted for by using the minimum, mode, and maximum estimates that were documented for each care process, as was previously described in this chapter.

In general, the input data illustrated in Table 3.5 are either identical to those used in the first report or have been improved based on new data collected since that report. In all cases where data were ambiguous or incomplete, investigators estimated times in a low direction (e.g., assumed that exercise for continent residents could be effective if offered 20 minutes every other day because one study reported that low estimate). Finally, it should also be noted that the time to provide incontinence care, exercise, and feeding assistance to responsive residents also included the time required to communicate with the residents in a professional and respectful fashion. However, investigators could only assume that the other care process times that were derived from the published literature also included these communication times in their estimates.

3.8 Results

Table 3.6 provides a summary of the outcomes of different staffing levels by resident workload. Listed in the first two rows of this table, is a description of the different staffing levels for which

investigators conducted simulations in the hypothetical 40-bed unit. The first column illustrates FTEs scheduled by shifts and the second column illustrates the same information expressed as a resident to aide ratio. For example, the first row illustrates a total of 18 FTEs were present across all shifts in the highest staffed facility which resulted in a resident/aide ratio of one aide to 4.4 residents, 5.7 residents, or 20 residents on the three shifts (second column). The next column in the table illustrates the outcome of the different staffing levels. For example, consider the two staffing extremes in this table. All care could be provided on a timely basis in low, medium, and high workload facilities with 18 FTEs (first row), whereas a home with eight FTEs (last row) could implement less than 80% of the care in all facilities with long waits for incontinence and missed meals in all facilities. Feeding assistance was prioritized and residents were allowed to first go without incontinence care or exercise in the simulations in which there was inadequate staffing to provide all care. The specific services that could not be delivered might change in other simulations which prioritized services differently.

In terms of key staffing transition points, consider the changes in daytime staffing levels which resulted in either some care either not being provided or an increase in waiting times. In regard to low workload facilities, a change from 15 FTEs to 14 FTEs resulted in increased waiting times for incontinence care but had no effect on meals. Alternatively, the same change from 15 to 14 FTEs resulted in increased waiting times for both meals and incontinence care in medium workload facilities (row 3 to row 4). Unfortunately, in a high workload facility, a change from 15 FTEs to 14 FTEs resulted in increased waiting times for incontinence care and in some processes being omitted altogether.

The key staffing transition points that adversely influenced outcomes are reflected better in Figure 3.1, which shows the percentage of recommended minutes of daily care omitted as staffing levels change in each type of home. This figure makes it clear that a major transition point for a high workload facility is from 15 FTEs to 14 FTEs and in all facilities there is a significant deterioration of services when FTEs change from 13 to 12.

Finally, Figure 3.2 illustrates the proportion of available time that staff would have to work to produce the outcomes listed in Table 3.6. A time utilization ratio of 80 to 90 percent (of available time worked) is considered highly productive in other work settings and utilization rates above 90 percent are probably unrealistic in even well designed and managed NFs. This figure indicates that in only the highest staffed facilities was time utilization ratios on all shifts below the 90 percent level.

Table 3.6
Summary Table: Effects of Different Staffing Levels by Patient Workload

Shift Staffing (FTEs)		Resident-to-Aide Ratio	Low Workload	Medium Workload	High Workload
Day	9	4.4	• All care provided • Timely meals • <30 minute wait for change	• All care provided • Timely meals • <30 minute wait for change	• All care provided • Timely meals • <30 minute wait for change
Evening	7	5.7			
Night	2	20.0			
Day	8	5.0	• All care provided • Timely meals • <30 minute wait for change	• All care provided • Timely meals • <30 minute wait for change	• All care provided • Timely meals • <30 minute wait for change
Evening	6	6.7			
Night	2	20.0			
Day	7	5.7	All care provided • Timely meals • <30 minute wait for change	All care provided • Timely meals • <30 minute wait for change	>90% care provided • Timely meals • 30-60 min. wait for change when done
Evening	6	6.7			
Night	2	20.0			
Day	7	5.7	All care provided • Timely meals • 30-60 minute wait for change	All care provided • Meals >2 hrs late • 30-60 min. wait for change	>90% care provided • Meals >2 hrs late • 30-60 min. wait for change when done
Evening	5	8.0			
Night	2	20.0			
Day	7	5.7	All care provided • Timely meals • 30-60 minute wait for change	All care provided • Meals >2 hrs late • 1-2 hour wait for change	>90% care provided • Meals >2 hrs late • 1-2 hour wait for change when done
Evening	5	8.0			
Night	1	40.0			
Day	6	6.7	All care provided • Timely meals • 1-2 hour wait for change	>90% care provided • Meals >2 hrs late • 1-2 hour wait for change when done	80-90% care provided • Missed meals • 1-2 hour wait for change when done
Evening	5	8.0			
Night	1	40.0			
Day	6	6.7	>90% care provided • Meals >2 hrs late • 1-2 hour wait for change when done	80-90% care provided • Missed meals • 1-2 hour wait for change when done	80-90% care provided • Missed meals • 2-3 hour wait for change when done
Evening	4	10.0			
Night	1	40.0			
Day	5	8.0	80-90% care provided • Meals >2 hrs late • 1-2 hour wait for change when done	70-80% care provided • Missed meals • 2-3 hour wait for change when done	70-80% care provided • Missed meals • 2-3 hour wait for change when done
Evening	4	10.0			
Night	1	40.0			
Day	4	10.0	70-80% care provided • Missed meals • 2-3 hour wait for change when done	70-80% care provided • Missed meals • 2-3 hour wait for change when done	<70% care provided • Missed meals • >3 hour wait for change when done
Evening	4	10.0			
Night	1	40.0			
Day	4	10.0	70-80% care provided • Missed meals • 2-3 hour wait for change when done	<70% care provided • Missed meals • 2-3 hour wait for change when done	<70% care provided • Missed meals • >3 hour wait for change when done
Evening	3	13.3			
Night	1	40.0			

Figure 3.1. Percent of Recommended Minutes of Daily Care Omitted By Staffing and Workload

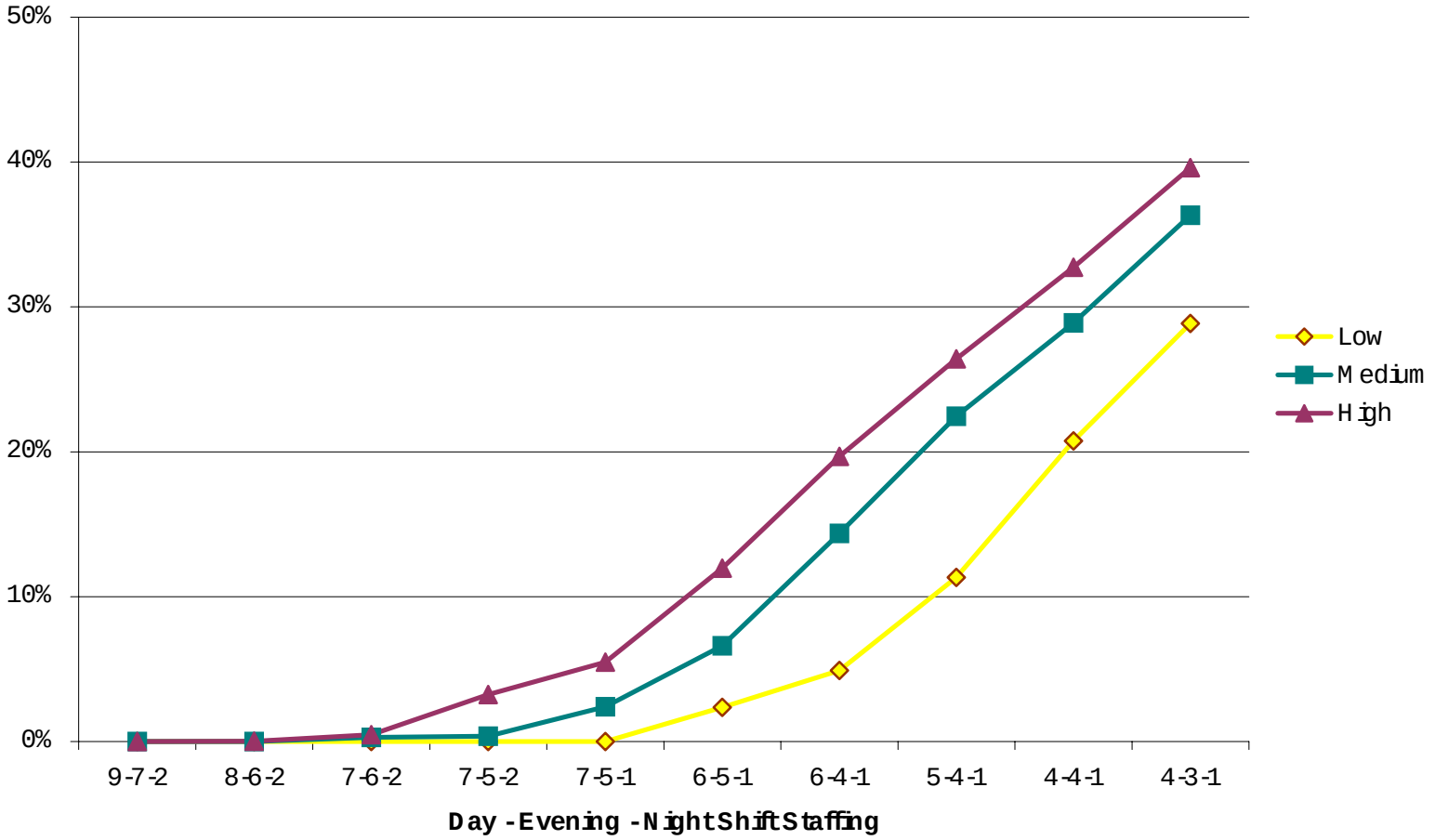
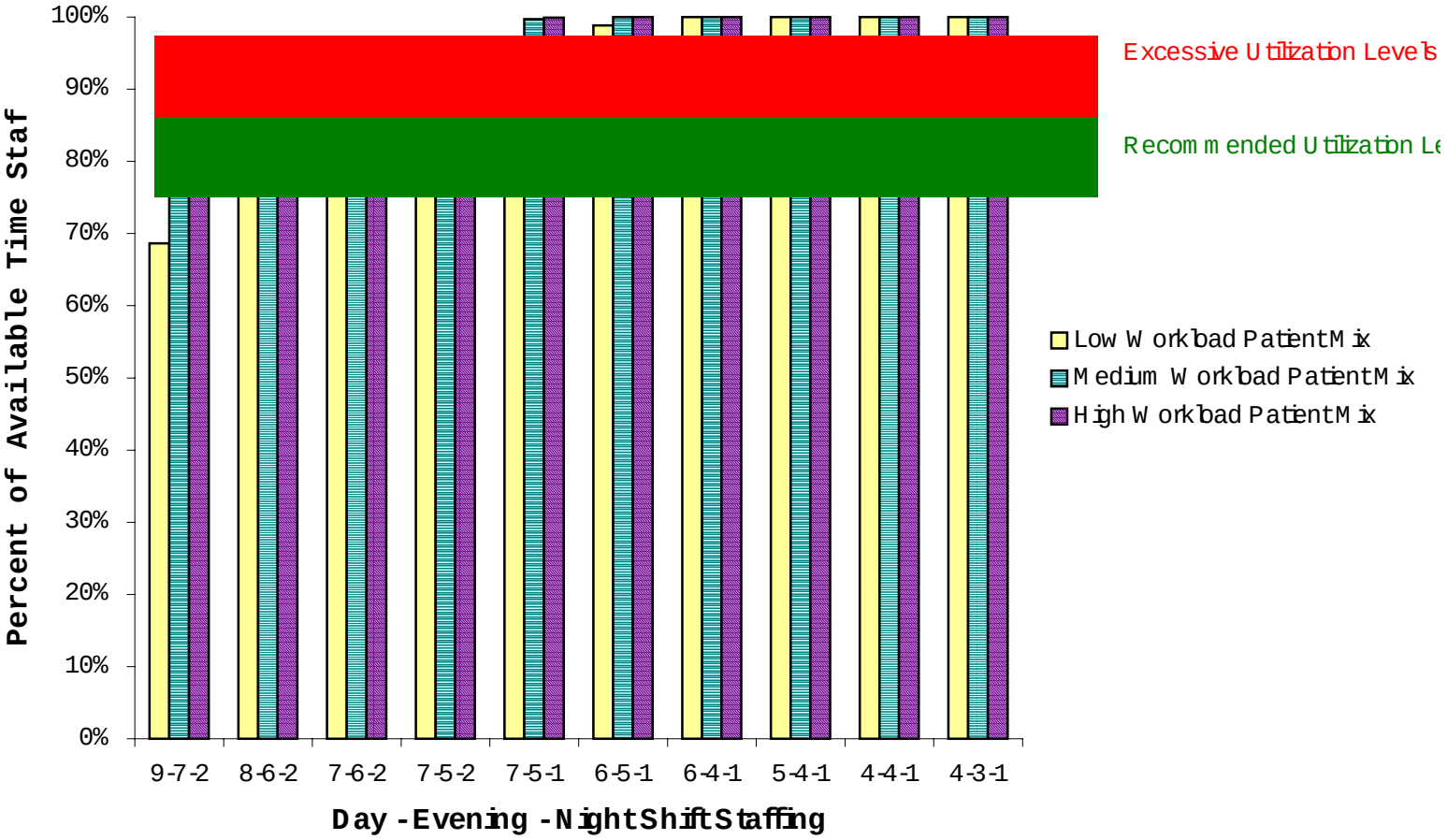


Figure 3.2. Overall Staff Utilization by Staffing and Workload



Three additional explanatory comments about the data in Figure 3.2 should be made. First, staffing changes on one shift do effect how hard staff must work on other shifts. For example, Figure 3.2 illustrates that two aides would have to work harder on the 11pm – 7am shift when staff was reduced by one on the other shifts, since all care could only be provided if the 11pm – 7am shift provided more am care and started earlier than 6 am to do so (see second and third set of bars on Figure 3.2). Secondly, investigators did not vary staffing on the 11pm – 7am shifts beyond two FTEs because the effects of changing staff on this shift were minimal. The staff on the 11pm – 7am shift have to work at unrealistically high productivity levels only when care processes could not be completed on the other shifts because of inadequate staffing. In general, care processes can be more efficiently implemented by increasing staff on shifts other than the 11pm – 7am shift. Finally, more efficient use of staff may be achieved without sacrificing the needs of residents by employing part-time staff with shifts tailored to peak workload times of day (for example, the use of one full time and one part-time aide on the 11pm – 7am shift or the use of part-time aides in the early morning). Investigators did not include the use of part-time aides in these simulations, because this is not widespread industry practice.

3.9 Conclusions: Study Results

- The minimum number of FTEs necessary to provide all care on a timely basis in a 40-bed unit varies from 16 for a high workload home to 14 for a low workload facility.

- A change in staffing from 16 to 15 FTEs in a high workload facility results in both a reduction in the number of services that can be provided and an increase in waiting times. A similar deterioration in services occurs in the low workload facility when staffing changes from 12 to 11 FTEs.

- Staffing levels that are similar to those reported in many of the nation's NFs (ratio of 8:1 day shift; 10:1 evening shift; 20:1 night shift) results in very long waits for services, and no assistance during meals for many residents, even when staff work hard.

3.10 Future Directions

This report has improved the understanding of how variations in the resident mix in NFs influence the staffing requirements necessary to provide care. However, the analysis that investigators report in this chapter suffers from many of the same problems that investigators reviewed in the first report. Most notably:

1) Investigators did not conduct simulations on all care processes that residents might need such as clinical services that could impact scheduling and delivery of nurse aide care. For example, if aides must transport residents to specialized therapy, such as PT or clinics, then preparing and transporting the resident can consume significant amounts of time. In regard to direct care processes, the most controversial processes that were

excluded may be those designed to improve quality of life or to manage behavioral and mood-disturbance problems. These processes were excluded either because of the lack of more definitive information that they change outcomes or lack of specific information about the time required to implement the processes. In addition, all the care processes that were the focus of this report did involve significantly increased social interaction between residents and nursing facility staff. To the extent that one believes that increased social interaction and personal contact improves resident's quality of life or agitation and mood, then these outcomes should also improve following implementation of the five protocols that are the focus of this report.

2) The time data and frequency of care input data that investigators utilized are based on assumptions in some cases because of the absence of definitive, published time/motion data.

3) Investigators did not simulate the staffing requirements to individualize care, but instead chose the most efficient schedule to deliver care, which was the same for all residents.

4) Investigators did not simulate the effects of varying management practices (such as use of part-time personnel or staggered shifts), which would effect staff workload and estimates of staffing requirements to implement care.

5) Related to point 4, investigators did not estimate the licensed nurse labor requirements to manage aides or to implement these care processes under the control of licensed nurses (resident assessment).

Investigators can see two possible solutions to these problems. The most immediate solution is to use the simulation model framework that investigators have constructed for this report with different input variables that might be suggested by long-term care experts or practitioners. For example, if there is concern that the exercise time and frequency input variables that investigators used are unrealistic (too high or too low) investigators could easily complete simulations with different exercise numbers. It would be helpful if a panel of stakeholders were convened to identify what care process variables or management assumptions would improve the current simulations and also be realistic to model. The second solution to this problem is more long-term. Applied research could be conducted in NFs for the purpose of determining the staffing requirements and resources necessary to implement care processes consistent with OBRA regulations and practice guidelines. This research could actively implement all desired care processes under controlled conditions while also evaluating interventions to improve efficiency. This realistic field test would most certainly help verify the arbitrary productivity assumptions that were utilized in this chapter and would also identify subtle aspects of the nurse aide job that consumes time. The Institute of Medicine made a similar recommendation in their recently released report on the quality of long-term care.[13] This recommendation is listed as follows:

"Recommendation 7.1: The committee recommends that the Department of Health and Human Services fund research to examine the actual time and staff mix required in different long-term care settings to provide adequate processes and outcomes of care consistent with the needs and variability of consumers in these settings, and the fit between these needs and other existing staffing patterns. The Committee further recommends that the Department of Health and Human Services, by establishing Centers for the Advancement of Quality in Long-Term Care, initiate research, demonstration, and training programs for long-term care providers to redesign care processes consistent with best practices and improvements in quality of life."

3.11 Conclusion: Setting Nursing Home Nurse Staffing Standards

3.11.1 Study Question: How Should Appropriateness Be Defined?

This and the preceding chapter constitutes the core empirical analyses for addressing the current concern about inadequate nursing home nurse staffing, and a long-standing requirement for a study and report to Congress on the "appropriateness" of establishing minimum nurse staffing ratios. The Congressional language was clear, but sparse and it was necessary to operationalize "appropriateness" so that there were study questions open to empirical investigation. Consistent with this objective, the analysis presented in Chapter 2 defined two key study questions: Is there some ratio of nurses to residents below which nursing home residents are at substantially increased risk of quality problems? Conversely, is there some ratio of nurses to residents above which no additional improvements in quality are observed?

As we have seen from chapter 2, this Phase 2 analysis provided further strong evidence supporting the existence of the nurse staffing ratio thresholds below which quality of care is compromised and above which there is no further significant benefit of additional staffing with respect to quality. This finding would seem to be a necessary condition for considering any minimum ratio staffing requirement. Absent this finding, arguably no minimum staffing requirement could improve quality. In contrast, if the relationship between staffing and quality is real and substantial, then a minimum requirement set at any point up to and including the identified thresholds would improve quality; higher requirements above the thresholds would not result in more improvement. Of course, the appropriateness of establishing a new regulatory minimum would also have to assess the costs, feasibility of implementation, other aspects of staffing (e.g., staff allocation, knowledge and training, supervisions, turnover/retention, and management practices), and other considerations discussed in this Phase 2 report. What is important to note here is that this conceptualization of appropriateness is what is expected from a regulatory agency; regulatory standards are typically *minimal* standards.

The "appropriateness" of minimum staffing ratios, however, could be defined as the staffing threshold required to attain good or optimal quality outcomes, as opposed to avoiding bad outcomes. Although the definition of appropriateness implicit in Chapter 2 as minimal ratios is consistent with normal regulatory standards, the alternative definition of appropriateness as optimal ratios would seem consistent - even required - by current statutes and regulations. As discussed in greater detail in Chapter 4 of our Phase 1 Report, The Omnibus Budget Reconciliation Act of 1987 (OBRA '87) provided amendments to the Social Security Act (SSA) for Skilled Nursing Facilities (SNF) and Nursing Facilities (NF). The statutory language throughout these amendments and regulations and guidelines promulgated under OBRA '87 placed emphasis upon providing the scope of care and services (including sufficient qualified staff) for a resident residing in a LTC facility to assure that each resident could attain or maintain his/her highest practicable physical, mental, and psychosocial well-being. Hence, it would appear that CMS's *current* staffing regulations, particularly the general regulation requiring ". . . sufficient nursing staff to attain or maintain the highest practicable . . . well-being of each resident . . .," are intended to provide appropriate care conceptualized as an optimal standard, not a minimal standard.[4]

With respect to what is appropriate nurse aide staffing, the analysis presented in this chapter is consistent with identifying a minimum ratio necessary for attaining optimal quality outcomes. Essentially, the analysis asks how much nurse aide time is required to implement five specific, daily care processes that have been linked to (good) resident outcomes: toileting assistance and repositioning residents, feeding assistance, exercise, changing wet clothes and repositioning residents, dressing/grooming independence enhancement (morning care). The simulation analysis estimates these times for seven major categories of residents with different functional limitations and care needs. The nursing aide workload varies by the distribution of residents among these categories within facilities. The distribution of nurse aide workload among all facilities can be divided into three equal groups – low, medium and high workload facilities. Separate simulations were performed for each of the three types of facilities. Obviously, these five care processes are not a complete list of what nurse aides must do, and the analysis took into consideration such things as shower assistance, p.m. care, housekeeping duties (e.g., changing bed linens), and random, unscheduled demands for services (e.g., responding to patient call lights, spills, accidents, and similar events).

The three simulations estimated that the average number of *minimal* nurse aide staff *necessary* to provide all services (i.e., the stated OBRA '87 standard) that can benefit a hypothetical 40 resident unit of low, medium, and high average workload to be 14, 15, and 16 FTEs, respectively. This is equivalent to 2.8, 3.0 and 3.2 hours per resident day, respectively. This is an estimate of the minimally necessary nurse aide staff to provide

[4] With the repeal of the Boren Amendment in 1997, it would appear that Congress does not now require that the States Medicaid nursing home payment rates must be sufficient to provide " . . . services required to attain or maintain the highest practical physical, mental and psychosocial well-being of each Medicaid resident . . ." Nevertheless, the OBRA "highest practical" quality standard remains unchanged. See Phase 1 Report, Chapter 2, and Chapter 11 of this Phase 2 Report for a discussion of the Boren Amendment and State Medicaid payment rates.

optimal care. *This standard should be viewed as a necessary condition for optimal care by nurse aides, not a sufficient condition*. Obviously, the other licensed categories of nursing, RNs and LPNs are also important, as demonstrated from the findings presented in other chapters in this Phase 2 report.

The simulation estimate *assumes* a very highly motivated and productive nurse aide staff. Even under conditions of nurse aide staffing that meets or exceeds these thresholds of potentially available time, what nurse aides actually do and accomplish with respect to patient care is dependent upon a sufficiently skilled licensed staff to supervise aides as well as other organizational factors. It is important to note that the nurse aide threshold identified in chapter 2 for the long-stay population, 2.8 hrs./per resident day, is only slightly less than the median threshold of about 3.0 hrs. estimated from the simulation analysis of this chapter. This does not mean that the difference between a minimal and optimal standard is only 0.2 hrs. The evidence from chapter 2 indicates that a minimum requirement of 2.8 hrs/per resident day would yield the maximum quality attainable with the knowledge, skill, and managment practices currently found in nursing homes. The slightly higher threshold of 3.0 nurse aide hrs/ per resident day identified in the simulation analysis will not yield *under current conditions* an optimal or even more quality. But if one *assumes* very high motivation, knowledge, and productivity – conditions currently not typically found in nursing homes – then an optimal standard will be achieved.

A minimum requirement set at any threshold will entail added costs. The evidence from chapter 2 indicates that minimum requirements set higher than the identified thresholds would entail higher costs with no significant improvement in quality. Hence, added resources beyond that necessary to staff at the thresholds identified in chapter 2, would yield quality improvement if directed at other aspects of staffing than sheer numbers of staff. These include all the factors that make for the very high motivation, knowledge, and productivity assumed in the simulation model and discussed in various analyses in this report (see chapters 5, 6, and 7). Similarly, any minimum requirement will entail consideration not only of the added costs, but whether the additional resources could yield more quality improvement if directed at these other non-numerical staffing-related factors.

3.11.2 Applying the OBRA '87 Standard

As noted in this chapter, the simulations' estimate of minimally necessary nurse aide time is much higher than typically found in U.S. nursing homes. But how much higher? In Tables 3.7 – 3.11 below, we have estimated the number of homes that fail to meet the minimum thresholds associated with the nurse aide workload category assigned to each home. These estimates require generating from MDS data a workload category for each home, and linking that category with the actual nurse aide staffing, derived from OSCAR data. Depending on the distribution of residents between workload categories *within* each home, each nursing

home is assigned an average nurse aide workload score.[5] Each home is then rank ordered and one-third assigned to each of the three categories. As can be seen in Figure 3.3, the distribution of nursing homes is approximately normal with a median value of 1.76.

We have utilized a modified OSCAR data set to generate the estimate of the number of homes that fail to meet the staffing thresholds associated with the low, medium, or high workload categories.[6] As was discussed in greater detail in Chapter 7 of the Phase 1 Report, this OSCAR file has been created with decision rules that improve the accuracy and reliability of the reported data.

As we can see from Table 3.7, the vast majority of nursing homes in the U.S., over 91 percent, fall below the threshold associated with their nurse aide workload category. Over 40% of *all* nursing homes would need to increase nurses aide staffing by 50% or more to reach the minimum threshold associated with their workload category, and over 10% would need to increase their nurse aide hours in excess of 100 per cent.

- Only 6% of freestanding facilities exceeded their associated minimum thresholds. Although the impact was less for hospital-based facilities, only 25% exceeded the thresholds.

- Reflecting the lower staffing levels of for-profit facilities, minimum nurse aide staffing requirements associated with these thresholds would affect more facilities than non-profit or government facilities. Ninety-five percent of for-profit facilities fell below their associated thresholds, compared to 85% of non-profits and 79% of government facilities.

- The percentage of facilities failing to meet the thresholds associated with their workload group varied somewhat: for the high workload group (3.2 hrs/resident day threshold), 93.5 % fell below threshold; for the medium workload group (3.0 hrs/resident day threshold), 93.4% fell below threshold; for the low workload group (2.8 hrs/resident day threshold, 87.4% fell below threshold (Tables 3.7-3.10).

3.11.3 Is the OBRA Optimal Staffing Standard Attainable?

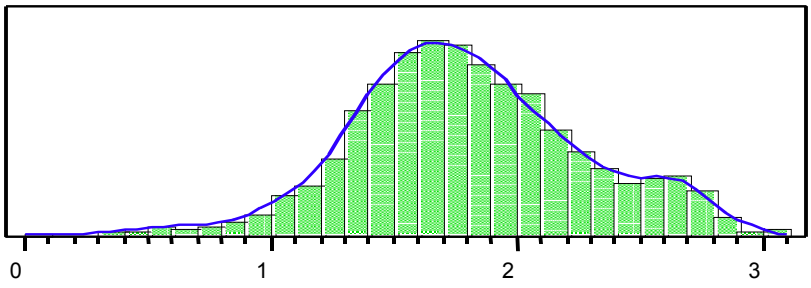
The findings produced here raise serious doubts whether this minimal optimal standard is a

[5] Depending on a configuration of MDS elements, each resident receives an associated number of workload points which vary between zero and three (see Table 3.3). These points are summed over all residents and divided by the total number of residents to obtain an average workload score for the nursing home.

[6] The staffing data were derived from the most current surveys conducted between October 1999 and March 2001. The decision rules entailed some deleted observations resulting in nurse aide staffing data for 16,224 nursing homes. These homes were linked to MDS assessment from which we derived the workload estimates. MDS assessments were selected from the quarter nearest the survey date. For some homes the identification number did not provide a link. The tables in this chapter are based on the final linked dataset of 14,060 nursing homes.

realistic goal. Clearly, a very large percentage of facilities fail to meet this standard and a significant percentage fails by a very wide margin. This failure is compounded when one takes into consideration that these thresholds are lower bound estimates for providing all needed care. As was shown in this chapter, the simulations assume very little unscheduled care demands, and what might be considered unrealistic high levels of on-task work performance and productivity for a health care worker. It also assumes a convenient physical layout, and a deployment of staff in what was recognized as an unrealistically efficient manner. More realistic assumptions would clearly raise the thresholds and the estimated number of facilities that fail to meet them. And, as note above, even if nurse aide staffing levels were to be raised to these very high levels, the evidence from chapter 2 indicates that quality would not be improved unless there was also improvement in motivation, skill, and productivity of nursing staff.

Figure 3.3
Nurse Aide Workload Distribution, U.S., 2000



Average Nurse Aide Workload Score

Source: MDS, OSCAR

Table 3.7
Staffing Levels in U.S. Nursing Homes: Impact of Optimal Nurses Aide Staffing Requirement, All Homes, 2000

	PROPORTION < MINIMUM	Proportion needing to increase by:						
		1-10%	11-20%	21-30%	31-40%	41-50%	51-99%	>=100%
ALL-ALL	0.914	0.055	0.086	0.108	0.127	0.124	0.309	0.104
Freestanding	0.937	0.050	0.083	0.109	0.132	0.131	0.328	0.104
Hospital-Based	0.746	0.086	0.109	0.102	0.096	0.073	0.173	0.107
For-profit	0.948	0.038	0.067	0.097	0.130	0.132	0.365	0.118
Non-profit	0.864	0.084	0.124	0.130	0.124	0.110	0.212	0.081
Government	0.792	0.092	0.112	0.130	0.122	0.108	0.168	0.059

Note: The minimum nurses aide staffing level suggested by the simulation analysis is 2.8, 3.0, and 3.2 hrs./resident day for low, medium, and high workload homes,
respectively.

Source: OSCAR

Table 3.8
Staffing Levels in U.S. Nursing Homes: Impact of Optimal Nurses Aide Staffing Requirement, Low Workload Homes, 2000

	PROPORTION < MINIMUM	Proportion needing to increase by:						
		1-10%	11-20%	21-30%	31-40%	41-50%	51-99%	>=100%
ALL-LOW	0.874	0.066	0.101	0.119	0.132	0.117	0.239	0.099
Freestanding	0.920	0.061	0.099	0.125	0.145	0.129	0.265	0.097
Hospital-Based	0.704	0.087	0.111	0.099	0.087	0.072	0.144	0.106
For-profit	0.928	0.045	0.082	0.113	0.152	0.133	0.291	0.112
Non-profit	0.807	0.098	0.134	0.129	0.102	0.095	0.167	0.083
Government	0.703	0.102	0.120	0.127	0.099	0.085	0.113	0.057

Note: The minimum nurses aide staffing level suggested by the simulation analysis for low workload nursing homes is 2.8 hrs./resident day.

Source: OSCAR

Table 3.9
Staffing Levels in U.S. Nursing Homes: Impact of Optimal Nurses Aide Staffing Requirement, Medium Workload Homes, 2000

	PROPORTION < MINIMUM	Proportion needing to increase by:						
		1-10%	11-20%	21-30%	31-40%	41-50%	51-99%	>=100%
ALL-MED	0.934	0.053	0.089	0.114	0.137	0.133	0.322	0.086
Freestanding	0.945	0.050	0.087	0.113	0.140	0.138	0.333	0.084
Hospital-Based	0.803	0.097	0.105	0.120	0.103	0.083	0.188	0.108
For-profit	0.958	0.035	0.070	0.102	0.139	0.141	0.376	0.096
Non-profit	0.894	0.092	0.135	0.135	0.135	0.116	0.210	0.071
Government	0.845	0.092	0.102	0.155	0.125	0.122	0.201	0.046

Note: The minimum nurses aide staffing level suggested by the simulation analysis for medium workload nursing homes is 3.0 hrs./resident day.

Source: OSCAR

Table 3.10
Staffing Levels in U.S. Nursing Homes: Impact of Optimal Nurses Aide Staffing Requirement, High Workload Homes, 2000

	PROPORTION < MINIMUM	Proportion needing to increase by:						
		1-10%	11-20%	21-30%	31-40%	41-50%	51-99%	>=100%
ALL-HIGH	0.935	0.045	0.069	0.092	0.113	0.122	0.367	0.127
Freestanding	0.944	0.043	0.066	0.092	0.113	0.126	0.376	0.128
Hospital-Based	0.811	0.074	0.105	0.093	0.118	0.062	0.248	0.111
For-profit	0.957	0.036	0.051	0.078	0.100	0.123	0.422	0.146
Non-profit	0.905	0.060	0.102	0.125	0.139	0.121	0.269	0.089
Government	0.824	0.081	0.114	0.106	0.143	0.117	0.187	0.077

Note: The minimum nurses aide staffing level suggested by the simulation analysis for high workload nursing homes is 3.2 hrs./resident day.

Source: OSCAR

References

1. Health Care Financing Association. Report to Congress: Appropriateness of Minimum Nurse Staffing Ratios in Nursing Homes. Summer 2000.

2. Edmonds MI, et al. The use of computer simulation as a strategic decision-making tool: a case study of an emergency department application. *Healthcare Management Forum*. 1999;Fall,12(3):32-8.

3. Dexter F, et al. Statistical method to evaluate management strategies to decrease variability in operating room utilization: application of linear statistical modeling and Monte Carlo simulation to operating room management. *Anesthesiology* 1999; Jul;91(1):262-74.

4. Tucker JB, et al. Using queuing theory to determine operating room staffing needs. *Journal of Trauma* 1999; Jan;46(1):71-9.

5. Fries BE and Maranthe VP. Determination of optial variable sized multiple-block appointment systems. *Operations Research* 1981; 29: 324-328.

6. Myers JE, Johnson RE and Egan DM. A computer simulation of outpatient pharmacy operations. *Inquiry* 1972; 9: 40-47.

7. Hershey JC, Pierskalla W and Wandel S. Nurse staffing management. In *Operational research applied to health services* (D. Boldy, ed.) 1981 New York: St. Martin's Press.

8. Bagust A, et al. Dynamics of bed use in accommodating emergency admissions: stochastic simulation model. *British Medical Journal* 1999; 17; 319(7203): 155-8.

9. Schnelle JF, Cretin S, Saliba D, Simmons SF. Minimum Nurse Aide Staffing Required to Implement Best Practice Care in Nursing Homes. Chapter in Report to Congress: Appropriateness of Minimum Nurse Staffing Ratios in Nursing Homes. Health Care Financing Administration. Summer 2000, Volume II, Chapter 14.

10. Schnelle JF, Alessi CA, Simmons SF, Al-Samarrai NR, Beck JC, Ouslander JG. Translating Clinical Research into Practice: A Randomized Controlled Trial of Exercise and Incontinence Care in Nursing Home Residents. (In Preparation)

11. *Analysis for Public Decisions*, 3rd edition ES Quade, revised by Grace M Carter, North Holland, 1989.

12. Ouslander JF, Al-Samarrai N, Schnelle JF. Prompted Voiding for Nighttime Incontinence in Nursing Homes: Is it Effective? J Am Geriatr Soc. 2001;49:(6):706-709.

13. Committee on Improving the Quality in Long-Term Care, Division of Health Care Services, Institute of Medicine. Improving the Quality of Long-Term Care. Gooloo S. Wunderlich and Peter O. Kohler, Eds. National Academy Press. Washington, D.C. 2001 National Academy of Sciences.